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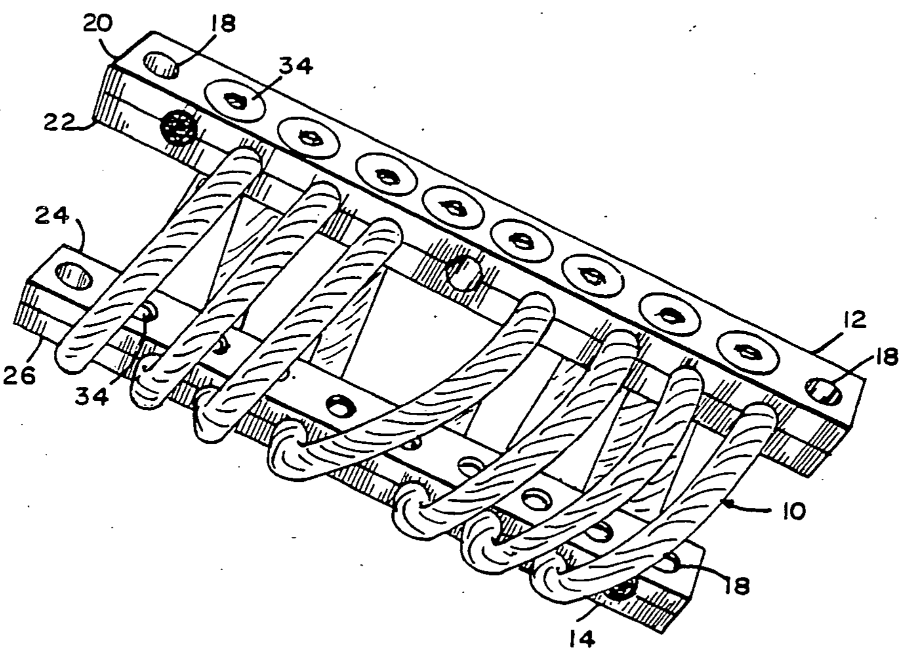

(57) Abstract

A shock and vibration isolator is provided comprising a wire cable (36) and sleeve (38) forming a continuous wire rope (16) helically wound and retained in clamped relation by a pair of spaced structural mounting members (12 and 14). Each of the mounting members comprises a pair of clamping bars (20, 22, 24, 26) having grooves formed in mating surfaces thereof for retaining the wire rope therebetween. The sleeve of elastomeric material has a modulus of elasticity significantly lower than that of the clamping bars and is disposed in enveloping engagement about the wire rope to provide a noise break. The grooves provided in the clamping bars form a circular or elliptical opening between the bars having a cross-sectional area which is of a greater dimension than the cross-sectional area of the wire cable, and of a lesser cross-sectional area than the wire cable to prevent slippage of the wire rope (16) in the mounting members (12 and 14).

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SHOCK AND VIBRATION ISOLATOR

Background of the Invention

The present invention relates to shock and vibration isolators and more particularly to a shock and vibration isolator within a wire rope, that is clamped in a helical shape between two structural bars, and serves to operate substantially as a spring.

In order to provide suitable mounting for instrumentation or other products to a base which is subject to shock and vibration, a number of shock and vibration isolating mounting devices have been developed over the years and have been successfully utilized to protect the product. One such device is a wire rope isolator wherein the wire rope is clamped in a helical shape between two structural members in the form of elongated bars. When the product is mounted on one of the structural members and the other mounted to a base, the device serves as a spring element between the product and the base. Generally, the wire rope is formed of a plurality of strands of small wires and any deflection therefore causes relative motion between these small wires and a resultant friction damping.

Supports of this type are well known in the art, and such structures are shown by way of example in U.S. patent 3,475,851 and U.S. patent 4,397,069, both of which are issued to C. Camossi. One area in which most of the isolators of the type described above have shortcomings is in the area of noise attenuation. Although a degree of attenuation is realized due to the dynamics of the isolation system, an elastomeric system of the same natural frequency and damping characteristics is a far superior noise attenuator. This is due to the fact that elastomers are less dense than metals, and elastomerics offer

greater impedance to the propagation of noise as sound travels faster through the more dense material and hence slower through the less dense material. In addition, at very small inputs typical of high frequency noise, there is very little motion between the wire strands which make up the wire rope, and therefore very little damping. At small inputs, the elastomeric, although it too has less damping, still maintains more damping characteristics than that which is apparent in the wire rope.

In the aforementioned U.S. patent 3,476,851, a solution to the problem of increasing the damping of mechanical vibrations in a support of the type under consideration has been proposed in which the support members or bars take the form of plastic supports which are made by a die casting process formed about the curved lengths of cable and providing a structure wherein the cable is imbedded within the two plastic bars. However, it is evident that in the design of such structure, the material provided in the cast bars must of necessity be a compromise between the rigidity required in mounting the product to the base and a desired elastomeric material which would produce the optimum damping effect.

Yet another problem inherent in isolators of the type under consideration is caused by contaminants working their way into the strands of the cable element and thereby reducing the damping qualities of the isolator. As previously discussed, the wire cable which is comprised of many strands of small wires, when deflected, causes relative motion between the wires and therefore friction damping. If foreign materials such as oil, solvents, or other contaminants, work their way into the cable element and enter between the strands, the coefficient of friction between the strands is less, and therefore damping is reduced.

It is therefore an object of the present invention to provide a shock and vibration isolator having

increased noise attenuation characteristics over those of the prior art.

A further object of the invention is to provide a shock and vibration isolator having damping characteristics which are not decreased over the life of the isolator due to the presence of contaminants in its working environment.

Yet another object of the invention is to provide a shock and vibration isolator of the type wherein a wire rope is helically wound and clamped between structural bars in which the structural integrity of the isolator is maintained while noise attenuation is increased.

Summary of the Invention

The aforementioned objects and other objects which will become apparent as the description proceeds are accomplished by providing a shock and vibration isolator comprising a pair of elongated, substantially rigid, mounting members disposed in spaced relation. A continuous helically wound rope interconnects the mounting members at a plurality of locations along the length of the members. Each of the mounting members further comprises a pair of elongated clamping bars, one having a surface with a plurality of equidistantly spaced, semi-circular or elliptical grooves formed therein and the other having a mating surface with mating semi-circular or elliptical grooves provided therein. When mated with one another, the pairs of semi-circular or elliptical grooves provide a plurality of substantially circular or semi-circular openings.

The helically wound wire rope is interlaced through the plurality of openings in each of the mounting members to interconnect the mounting members. A sleeve of elastomeric materials envelops

those portions of the wire rope disposed in the openings.

Means are provided for clamping each pair of clamping bars together whereby the elastomeric material is compressed to provide a noise break between the rigid mounting members. Further, with the wire cable enveloped by the elastomeric sleeve over the entire length thereof, a barrier is provided to eliminate foreign substances from contacting the wire cable during its use.

Brief Description of the Drawing

The foregoing and other features of the invention together with novel detail in construction will now be more particularly described in connection with an illustrative embodiment and with reference to the accompanying drawings wherein:

Figure 1 is a perspective view showing a shock and vibration isolator constructed in accordance with the teachings of the present invention.

Figure 2 is a side elevational view showing the shock and vibration isolator of Figure 1 taken on an enlarged scale for clarity.

Figure 3 is a sectional view taken along the lines III-III of Figure 3, taken on an enlarged scale and showing further details of the structure depicted in Figure 2 and Figure 3.

Description of the Preferred Embodiment

Referring now to the drawings, and in particular to Figure 1, there is shown a shock and vibration isolator 10 comprising a pair of elongated substantially rigid mounting members disposed in spaced relation and a continuous helically wire rope 16 interconnecting the mounting members at a plurality of locations along the length of each member. Each of the mounting members 12 and 14 is provided with an opening 18 disposed at each end thereof and formed through the member to provide for mounting a suitable component or product (not shown) onto a base (not shown).

Referring now to Figures 1 and 2, it will be noted that the mounting member 12 is formed of a pair of elongated clamping bars 20 and 22 and the mounting member 14 comprises a pair of clamping bars 24 and 26. The clamping bars 20 and 22 have mating surfaces into which are formed a plurality of semi-circular or elliptical grooves which form a plurality of substantially circular or elliptical openings 28 when the surfaces are in mating relation. In similar fashion the clamping bars 24 and 26 have mating surfaces which are provided with semi-circular or elliptical grooves which form a plurality of openings when the mating surfaces of mating bars 24 and 26 are disposed as shown. Between each of the openings 28, a fastener 32 extends through a hole in the bar 20 and threadably inserted into the bar 22 to provide clamping of the bars in the assembly. Likewise, the clamping bars 24 and 26 are provided with a plurality of fasteners 34, one provided between each of the openings 30 and each extending through a hole provided in the clamping bar 26 and threadably received in the clamping bar 24 to provide clamping of the bars together.

The clamping bars 20, 22, 24 and 26 are preferably formed of aluminum, steel or other substantially

rigid material in order to provide an appropriate support for the component or product which is to be assembled to the base.

Reference should now be made to Figure 3 wherein the wire 20 rope 16 is shown to comprise a plurality of cable elements in the form of metal strands 36 which are enveloped by an elastomeric sleeve or sheaf 38. The strands 36 are preferably of stainless steel material and the sleeve 38 is formed of an elastomeric material having a modulous significantly lower than that of the clamping bars and preferably of a urethane or polyethylene material.

In the construction of the shock and vibration isolator 10, it is essential that the portion of the wire rope 16 passing through an opening 28 or 30 be clamped between the clamping bars 20, 22, 24 or 26 such that movement or slippage between the clamping bars and the wire rope does not take place. Any motion between the wire rope 16 and the mounting members 12 or 14 would substantially change the vibration damping and shock resistant characteristics of the isolator 10.

To provide a clamping force between the clamping bars 20 and 22 and between bars 24 and 26, the cross-sectional area of the openings 28 and 30 are formed such that they are larger than the cross-sectional area of the cable 37 formed of the wire strands 36 and smaller than the cross-sectional area of the wire rope 16. Since the wire rope 16 is made up of the cable 37 and the sleeve 38, variations may take place over the length of the wire rope and therefore by dimensioning the openings 28 and 30 in the manner described, an interference fit is insured at each point of contact between the clamping bars 20, 22, 24 and 26 and the wire rope 16.

In the shock and vibration isolator disclosed, it is found that the introduction of the elastomeric material between the mounting members 12 and 14 and wire rope 16 is effective to substantially reduce

noise by providing a break in the noise path at each point of contact between the mounting members and the wire rope. Further, by extending the sleeve 38 over the entire length of the wire rope 16, a sheaf is provided which prevents oil, solvents or other foreign material from entering between the strands 36 and reducing the coefficient of friction between the strands.

Having thus described my invention, what I claim as new and desire to secure as Letters Patent of the United States is:

1. A shock and vibration isolator comprising:

a pair of elongated substantially rigid mounting members disposed in spaced relation;

a continuous helically wound wire rope interconnecting said mounting members at a plurality of locations along the length thereof;

each of said mounting members further comprising a pair of elongated clamping bars, one having a surface with a plurality of spaced semi-circular or elliptical grooves formed therein and the other having a mating surface with mating semi-circular or elliptical grooves provided therein to form a plurality of substantially circular or elliptical openings through a respective mounting member with said surfaces mated with one another;

said helically wound wire rope being interlaced through said plurality of openings in each of said mounting members to interconnect said mounting members;

said wire rope comprising a wire cable and a sleeve of elastomeric material enveloping those portions of said wire cable disposed in said openings; and

means for clamping each said pair of clamping bars together whereby said elastomeric material is compressed, providing a noise break between the rigid mounting members.

2. A shock and vibration isolator as set forth in claim 1 wherein said wire cable comprises a plurality of wire strands and is enveloped by said sleeve of elastomeric material over the entire length thereof.

3. A shock and vibration isolator as set forth in claim 1 wherein said rigid mounting members are formed of metal and said elastomeric material is a urethane material.

4. A shock and vibration isolator as set forth in claim 1 wherein said rigid mounting members are formed of metal and said elastomeric material is a polyethylene material.

5. A shock and vibration isolator as set forth in claim 1 wherein said openings formed by said grooves are of a greater cross-sectional area than the cross-sectional area of the said cable, and are of a lesser cross-sectional area than said cable and sleeve combination with said sleeve of elastomeric material enveloping said cable to form said wire rope.

6. A shock and vibration isolator as set forth in claim 1 wherein said means for clamping each said pair of clamping bars together comprises a plurality of threaded fasteners, one located between each of openings and each rotatable independently to move said clamping bars together or apart as desired to adjust the clamping force at a opening.

7. A shock and vibration isolator as set forth in claim 6 wherein said wire cable comprises a plurality of wire strands and is enveloped by said sleeve of elastomeric material over the entire length thereof.

8. A shock and vibration isolator as set forth in claim 7 wherein said openings formed by said grooves are of a greater cross-sectional area than the cross-sectional area of said wire cable, and are of a lesser cross-sectional area than said cable and sleeve combination with said sleeve of elastomeric material enveloping said cable to form said wire rope.

9. A shock and vibration isolator as set forth in claim 8 wherein said rigid mounting members are formed of metal and said elastomeric material is a urethane material.

10. A shock and vibration isolator as set forth in claim 8 wherein said rigid mounting members are formed of metal and said elastomeric material is a polyethylene material.

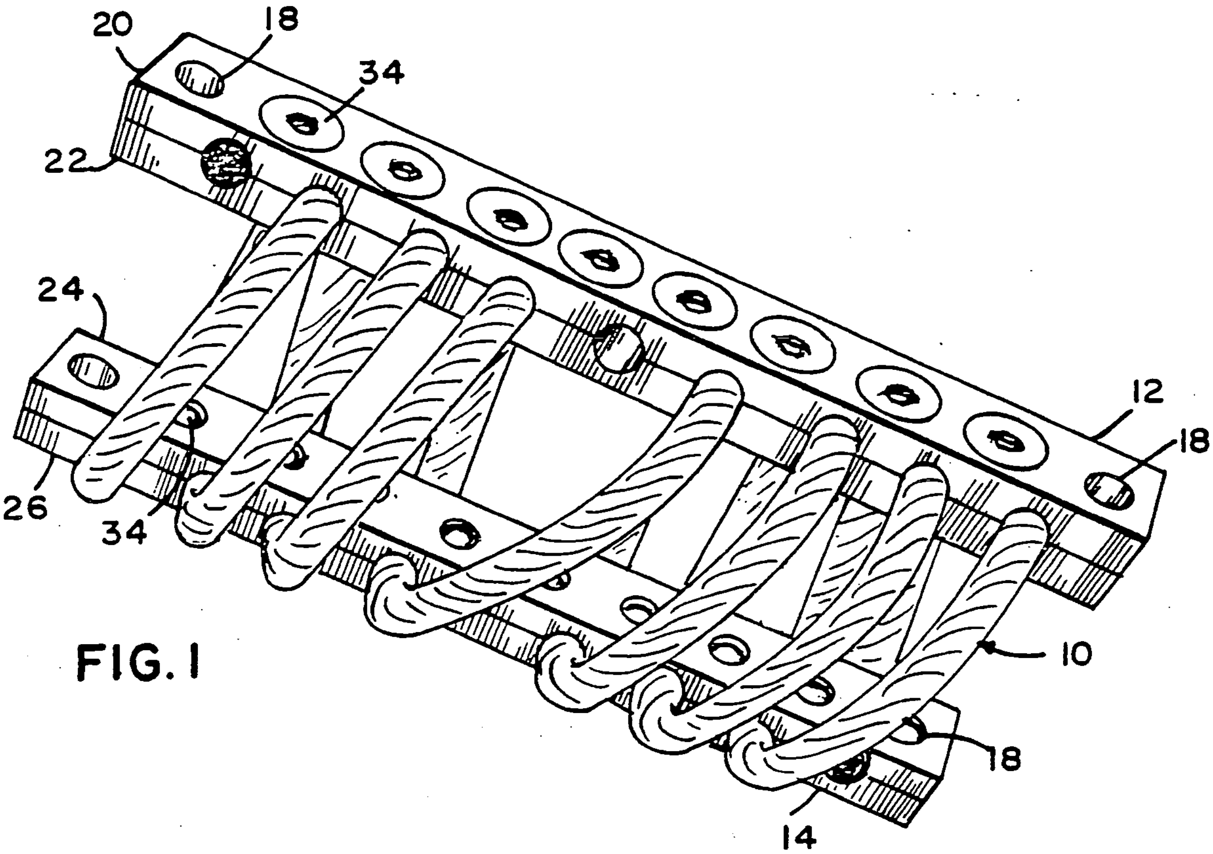

FIG. 1

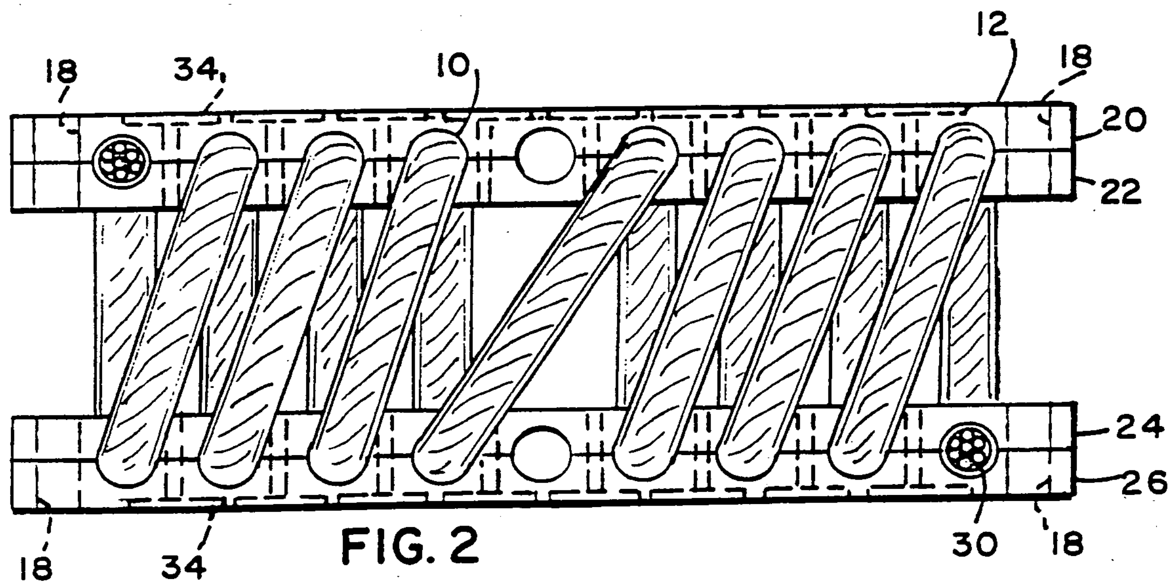

FIG. 2

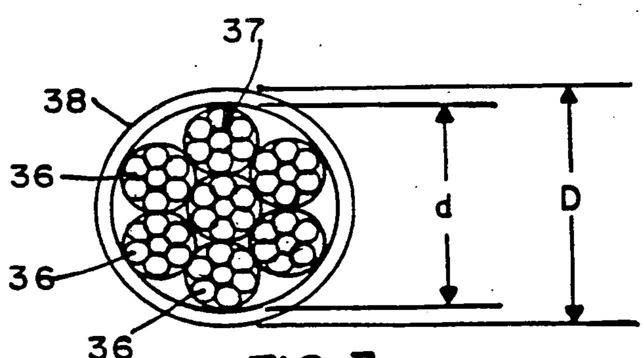

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US88/01547

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols ·ply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

I.P.C. (4) : F16F 1/04; B60G 11/56
U.S.Cl. 267/166

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.Cl.	267/33,148.152,166,178; 248/570,636; 29/173

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	US, A, 4,397,069 (CAMOSSI) 09 August 1983	1-10
Y	US, A, 3,096,084 (OSTERHOUDT) 02 July 1963 (See Fig. 1 and column 2, lines 10-12)	1-10
A	US, A, 4,190,227 (BELFIELD ET AL.) 26 February 1980	
A	US, A, 3,476,851 (CAMOSSI) 04 November 1969	
A	US, A, 2,972,459 (KERKEY JR., ET AL.) 21 February 1961	

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
03 August 1988	03 OCT 1988
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ISA/US	M. C. Graham MATTHEW C. GRAHAM